

Information technologies *in teacher education*

Issues and experiences for countries in transition

Edited by Betty Collis, Iliana Nikolova, Katerina Martcheva



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New Possibilities for Teacher Education Through Computer-Based Communication Technologies

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Abstract

Computer-based communication technologies are bringing new possibilities into teacher education in many different ways. As with distance education more generally they can facilitate flexibility in time and place of learning, but the range of persons and resources that they can bring to the teacher's computer screen are introducing many new scenarios into what is meant by "teacher education." In this review, we briefly consider nine cases of such new scenarios. We also consider issues common to them and conclude with a suggestion of a problem area for teacher education in contemporary Europe in which currently available computerbased communication technologies could play a particularly important role.

1. Setting the scene: Distance education for teacher education and computer-based communication technologies

1.1 Traditional needs stimulating distance education for teacher education

Distance-delivery methods for teacher education are well established throughout the world. For over 30 years such methods have been in formal operation (see Perraton, 1993, for a comprehensive overview). In many countries, distance-education methods

were taken up in order to rapidly expand the teaching force in response to public demands for more schools and teachers. The establishment of the Open University in the UK in 1969 led the way to legitimatisation and institutionalization of distance education as a higher-education delivery method; now many such formal institutions exist worldwide.

1.1.1 Motivations for distance-delivery of teacher education.

Ministries of Education have supported distance-delivery methods for teacher education for at least three general reasons: (a) to reach students who could not otherwise attend traditional training, thus adding more flexibility of location to teacher education; (b) to reach students who cannot or do not wish to attend full-time training, either because of already being in the work force, or for family or personal reasons, thus adding more flexibility of time to teacher education; and (c) to, at least in theory, introduce economies into teacher education by reducing overhead costs. Teacher-training institutions in many countries have had similar motivations for introducing distance-delivery methods, and have had the added motivation of hoping to tap a broader base of students in the process.

Thus, distance-education methods have:

...been used in rich and poor countries, for experienced and inexperienced teachers, at primary, secondary and tertiary levels, to provide a general education and to improve pedagogical skills, to overcome what was seen as a short-term crisis and to serve as part of a regular system of continuing education (Perraton, 1993, p. 3)

1.1.2 Various delivery methods for distance education.

Distance education is traditionally defined as an educational process in which a significant portion of the teaching is conducted by someone removed in space and/or time from the learner. Historically, most distance education, not only for teacher education but more generally, uses the method of sending printed lesson materials through the mails to the students, who work in a predominately self-study manner to complete activities based on the printed materials. Typically then the student mails the materials back to a tutor, who reviews them and provides some form of feedback, again often through the post.

However, many variations on this general model exist and are increasingly present in distance education. Some variations are organisational, in terms of intermixing some face-to-face contact among students and tutors with the self-study periods. Other variations relate to the addition of communication and interaction possibilities outside of face-to-face contact, most typically via the telephone but also through local "study center" support in which helpful humans are available, although probably not one's tutor or classmates.

A large area of variation in the method of distance education is that of the instrumentation or learning materials being used to support distance learning. Many distance-delivered programmes that started with only print as a delivery medium quickly augmented their learning materials to include audiotapes, videotapes, computer software, and learning kits of specialized equipment. Experience quickly proved that dis-

tance-delivered teacher education that relied on a single medium "were most likely to fail and to be closed down" (Brophy & Dudley, 1982).

A major need in distance education is that of providing human communication and interaction as well as well-designed learning materials. Thus communications technologies have gradually become established as part of the delivery infrastructure of distance education. Duning, Van Kekerix and Zaborowski (1993) note the following five phases of technologies in support of distance education:

Phase 1: Print (correspondence)

Phase 2: Print and audio (radio, audioconference, cassette)

Phase 3: Print, audio, and video (television, satellite, videoconference)

Phase 4: Print, audio, video, and computer (computer-assisted instruction, electronic mail)

Phase 5: Blend of technologies

In the next section we look the current position with respect to communication technologies from a perspective different from the historical one underlying the above list.

1.2 Communication technologies and distance delivery of education

1.2.1 Traditional forms of communication and their support technologies.

In general, in a distance-education situation, communication can be thought of relative to who and how many persons are wishing to talk to each other, and if they wish to be talking at the same time. We can define this as one-to-one, one-to-many, or many-to-many patterns of communication. The communication can be synchronous, (that is, occurring at the same time and interactively for all participants) or asynchronous (occurring at different times for different participants). Thus, two persons talking on the telephone is a common example of one-to-one synchronous communication, while a tutor leaving a message on a telephone answering service for any student who calls in that he is not available but that the next assignment is due a week later than originally announced is an example of one-to-many asynchronous communication.

1.2.2 Broadening the range: current forms of communication and their support technologies.

There are many other dimensions upon which modern communication in distance education settings can be categorised:

- We can communicate by voice or sounds (audio); by text; by pictures, graphics, video, and television; and by combinations of these. Thus modern communication technologies allow the passage of different media or combinations of media over a distance. Pictures, sounds, text, even some amounts of video, can all be converted to a digital form, which means that they can be sent from computer to computer.
- In addition, different combinations of communication technologies can be used in tandem: two-way audio connections (such as via telephone lines) can be combined with television-broadcast of video, and/or with interconnected flows of computer data. Thus individual or groups can communicate via text and/or visuals and/or

sound synchronously or asynchronously, depending on what communication technologies are available.

- Furthermore, the boundary between communication and information is now an overlapping one, as what one reads on one's computer screen may be the typed message from a classmate or tutor or a document from a set of resources provided for the distance-delivered learning situation or a document from a library or data base.
- Also, the way the signals are transmitted or carried can vary, in dimensions such as terrestrial (cables and wires) vs broadcast; or bandwidth.

There are now a large number of books and other references on communication technologies and their application in distance learning; as an excellent summary, see Van Den Brande, 1993. In this report, we shall only select a subset of possibilities. In addition, our focus will be on this subset's application to teacher education rather than on their technical characteristics.

1.3 Limiting the range for this paper: Some definitions

1.3.1 Restricting the analysis to computer-based communications.

A very large book could be written on the different possibilities of modern communication technologies for distance-delivered teacher education. Here, for space purposes, we will limit ourselves to situations in which all participants interact, at times that they choose (thus generally asynchronously, although it is possible that they all choose to interact at the same time), through direct use of a computer. Thus we will not include uses of television, such as television with one-way audio or with two-way audio; and thus not video conferencing or audio conferencing or audiographic conferencing. We know full well that communication technologies already allow video and audio signals to come directly into and through one's personal computer and that broadband communication channels such as ISDN will allow parallel flow of different data streams, but we will restrict ourselves to the type of situation that the majority of teachers could hope at the present time to confront relative to communication technologies--that of sitting at their own standard computers, with the computers connected to other computers and networks via a modem or via a direct connection to a local-area network.

1.3.2 Pertinent definitions.

With this limitation, we conclude this introduction with a list of pertinent definitions, which we will use without further technical discussion in the rest of this paper. Further elaboration of the definitions can be obtained in resources such as Bishop (1990) (from whom a number of the following definitions are taken, pp. 69-70); Collis (1993); Collis & De Vries, 1993; and Van Den Brande (1993).

Asynchronous communication: two-way communication in which there is a time delay between when a message is sent and when it is received.

Bulletin Board Service (BBS): A computer service that allows remote users to access a central host computer to read and post electronic messages and to upload and download files, all through a common menu.

Communication and information services for education: A service that organizes on-line communication and information-handling options and offers them in a integrated way to its users, and that generally supports the users of the service; sometimes called a "Network" or an "on-line service" (or many other names)

Communication technologies: technologies to transmit data signals over a distance

Computer-based communication: Making use of a computer as the platform for processing and transmitting information over a distance to and from another computer. The data may have originated as human communication or as electronically stored information .

Computer conferencing: Allows individuals at different locations to communicate directly with each other through computers, usually about a common theme, in a way that simulates some aspects of a face-to-face meeting; often with someone serving as the leader of the discussion (called the moderator), and sometimes with special computer software (called conferencing software) which makes it easier to keep track of what has been said by the various participants

CMC: computer-mediated communication. Similar to computer-based communication, but with the expectation persons talking with one another provide the major source of data for the communication

Electronic mail (e-mail): Electronic networking system that allows users to send and retrieve messages and files via computers.

Internet: An interconnected network of networks, extending all over the world, and supporting basic functionalities such as e-mail, file transfer, remote login and a common addressing protocol, so that a user can connect to literally millions of other users as well as thousands of collections of electronic resources and many different varieties of communication

Modem: A device that converts digital computer signals into analog format for transmission.

Network: A partly physical set of communication connections that allow widescale interconnectivity. "Network" is also used to refer to humans interrelated to each other through shared interests and communication channels

On-line data bases: Collections of digitally stored information accessible via communication technologies to an individual at a remote location

2. Examples of computer - communication technology in initial teacher education

Initial teacher education generally occurs in an institutional setting, with the student teacher dividing his or her time between formal courses in the higher-education institution and practical experiences in a school setting. Computer-communication technology

(called from now on in this report, for convenience, CCT) is bringing new experiences and possibilities into both aspects of initial teacher education. In this section, we briefly discuss these new possibilities under three general headings: (a) extending and enriching the traditional course environment in the initial teacher-education institute; (b) extending and enriching the communication and contact between student teacher, supervisor, and sponsoring teacher in the school; and (c) and bringing new sorts of partnerships in the initial teacher-education situation.

2.1 Extending and enriching the traditional course environment in the initial teacher-education institute

2.1.1 Enriching the traditional setting

It is now becoming typical to install a local-area network within any higher-education institution, including teacher education institutions. An example from the Liverpool Polytechnic (Stanley, 1991) shows some of the benefits:

Networks in Teacher Education Institutions: An example from the UK

- Libraries of exercise files available at all times on the network
- All software is available at any of the 26 computers located at different places in the institution
- The system menu provides a common and familiar user interface to the many different services and packages accessible through it
- Collaborative working can be facilitated, through students being able to individually contribute to a common task
- Joint and co-operative production of reports and projects
- Opportunity to leave and receive messages (Stanley, 1991)

Comes and Kirkwood (1992) give a similar example, from the United States. They note how students in initial teacher education can make use of the integrated information and communication resources at their institution (Ball State University) to access each other, the instructor, electronically stored library resources, external data bases and discussion groups, all from their rooms. The same communication system connects all the 200 classrooms at the University, so that transfer of text, voice, and/or video data can occur as it is wanted during class instruction.

This example can be extended to connect the multiple sites of an institution or to allowing a student, via a modem, to access the network from a remote location without always having to come into the institution. Hedberg and Harper (1993) give examples of this in Australia.

2.1.2 Reaching new groups of students.

There are many examples of CCT being used to bring initial teacher education experiences to groups of students who find it difficult or unattractive to come to traditional institutional settings. One such initiative is going on the UK, where the Open University is hoping to attract university graduates into a distance-delivered programme of initial teacher education. The programme will be part-time over 18 months, entirely offered by distance methods, with every student receiving a computer and modem as

part of the programme so that regular communication can occur between the student and the OU tutor, both while the student studies at home and when he does his required practice teaching in a school. The teacher-mentor in the school is also included in the computer conferencing (for information, contact F.Banks@Open.Ac.UK).

The LOTE Project in Australia is another example of the use of CCT to reach new groups of clients for initial teacher education. In the LOTE Project, the emphasis is on the development of modern language teachers, especially in remote areas. The same materials are also being used for teacher inservice in the same remote areas (Hedberg & Harper, 1993).

2.1.3 An institutional BBS.

Another example of the use of CCT in initial teacher education is that of the institutional BBS (bulletin board system), facilitating student and instructor interaction through the sending and reading of messages. One such system is that of the School of Education at California State University (Slovacek & Doyle-Nichols, 1992). A BBS was set up and a users guide was created, modems were given on loan to the students, and a fax board was installed in a computer on a cart for classroom demonstrations. Students could obtain a variety of types of information about their courses, could upload files and assignments, could connect to the Internet system, and could communicate with each other and their instructors. Usage increased steadily, with students becoming more and more likely to send messages to their instructors with regard to their assignments. This was seen to be important, not only to improve course performance, but also to "breaking down the barriers" between students and faculty.

2.1.4 Providing new types of course assignments.

In many initial teacher-education institutions CCT is being used to provide new types of course activities and assignments. The following example is an illustration:

Using CMC in a Teacher-Education Course on Critical Reading:

Students used a conferencing environment (called the "Round Table") to enter their comments and responses to various cases made available in the course or directly through the system

The Round Table software offered various options: a message facility with a flashing signal to show that a message was waiting; a pencil icon to be used to open a space for writing a comment; an "instructor area" where instructions on the cases to be read, an explanation of the issues in the cases, and key vocabulary could be found; a "brainstormer area" where students could enter their observations and link points electronically; an "argument analyzer" in which a structured organization was required Thor comments; and an "overview" function, where students could get a repeat of the entire conversation that had gone before, either in entirety or by scanning the first lines of the students' various comments

Students used the system to engage in these discussions whenever and from wherever they wished within a certain period.

The students were highly enthusiastic about the activity, and invested considerable energy in the discussions (Pugh, 1993)

These are just a few of the many examples of the use of CCT to enrich coursework in initial teacher education. Using CCT to enrich the practice-teaching aspect of initial teacher education is also proving to be a powerful application.

2.2 CCT and improved communication and support during the practical experience

It is now becoming common in many regions for CCT to be used to link students, instructors, and supervising teachers in regular communication during the practiceteaching component of initial teacher education. Such electronic linkage eliminates the frequently long stretches of time between visits of the faculty instructor to the school setting because of difficulties in time and organization to plan a visit to the school. Such a problem becomes critical in remote areas. The following is a typical illustration:

Using CCT for "Teleapprenticeships":

At the University of Illinois (USA) faculty, student teachers, and teacher-mentors make use of regular computer conferencing

Sometimes both student teachers and teacher-mentors entered reflective comments on their own teaching

Wide-ranging e-mail discussions are held concerning classroom experiences and their relation to theory; this occurs on a daily basis while student teachers are in the practical situation, through the loan of laptop computers and modems

Student teachers shared their lesson plans and experiences with each other on a daily basis and got quick feedback and comment from both their teacher-mentor and faculty supervisor, who could enter their observations at times convenient to themselves but within a short time after the practice lesson

Student teachers very much appreciate the rapid feedback, the on-line discussion among themselves and their supervisors, and the chance to keep in touch with each other when "in the field" (Levin, Waugh, Brown, & Clift, 1994)

2.3 New partnerships

A particularly powerful application of CCT in initial teacher education is in the facilitation of new sorts of partnerships in learning experiences for the student teachers. The PLUTO Project (see, for example, Libotton, 1989) is a major example. This project, with industrial support, linked as many as 19 initial teacher training institutions in 14 European countries with each other and with schools in their regions for various on-line collaborative projects, so that the student teachers could get a feeling of what such projects can offer to education and also a beginning sense of a didactic for such projects. In another example, of a smaller scale, 31 fifth- and sixth-grade children in Canada participated in an on-line project with 17 student teachers in California. The student teachers not only got to experience the management of an on-line activity while still on their own campus, but also had to develop strategies for tasks such as evaluating children's writing, and tailoring their language to be appropriate for discussion with a child. The on-line setting let this be done under the supervision and comment of the faculty instructor, something much harder to replicate in the full-scale practice-teaching situation (Zinck, 1989).

3. Examples of CCT in in-service teacher education

As was the case with initial teacher education, there are many new possibilities emerging in in-service teacher education through CCT. In this section we give some examples relative to CCT in in-service courses. In the following section, we extend the concept of in-service teacher education to include less-structured and more on-going sorts of professional development.

3.1 CCT-supported courses for in-service

CCT can augment a course which meets occasionally in a face-to-face warmer, or it can be the major vehicle through which the teachers involved participate in the course.

3.1.1 *Combining face-to-face and CMC.*

There are many examples of in-service courses which relieve some of the time and travel burden on teachers by replacing some of the time to be spent in the course in a face-to-face basis with study done at a distance, using CCT. The following is an illustration:

CCT Support for In-service Teacher Education in Catalonia

Teachers want to participate in various in-service programs, but find it difficult to move from their homes and working centres to Barcelona and to pay for their travel and expenses

Thus CCT became not only a topic to teach about in some of these courses, but also a training communication channel

The region had set up a Network and its associated service, with on-line data bases of educational resources for teachers to use in their lessons; the Network also supported a computer conferencing system called AGORA

Teachers received a variety of materials: text materials, a computer-based tutorial on how to use the on-line system, complementary readings and software on disk, and a user handbook

Face-to-face meetings were also held, to give the teachers instruction in how to use the different media and particularly the conferencing and e-mail options (Simon, 1992)

Other examples similar in various ways to the Catalonian illustration can be found in many countries. In the USA, for example, the "Mathematics Learning Forums Project" involves a particular institution (the Bank Street Center for Children and Technology and Graduate School of Education) leading a series of 24 on-line seminars in which teachers across the country can take part. Each on-line seminar lasts about two months. Participating teachers are first sent videotapes to give them "a vivid picture of the aspects of teaching about which they are learning", as well as various print materials. In the on-line conversations that go on throughout each seminar, faculty at the Bank Street institution will guide their teacher-students as they try new teaching strategies in their classrooms. The teacher-students will discuss with each other, via computer conferencing, their experiences with the new teaching strategies. Approximately 750 teachers are participating in the on-line seminars (Honey, 1993).

3.1.2 Supporting distance education through an "information network"

The LEARN Project in Denmark is a good example of a situation in which CCT is being used in a comprehensive way to support a number of distance-delivered teacher education courses, involving not only Danish teachers but teachers in other countries. The next illustration gives more detail:

LEARN: Comprehensive Support of Distance Education

LEARN is a Network Service offered in co-operation with the Royal Danish School of Educational Studies and Computer Resources International

LEARN provides a number of facilities which make it easy for students, tutors and administrators to perform distant education

From the student's point of view, LEARN is seen as a software package which makes it easy for the student to get and send mail, assignments, and other course materials; which includes an integrated text editor for editing responses, notes, and e-mail; which offer menu-driven access to various file-handling tasks; and which support a BBS and various communication options. Students study off-line.

From the tutor's point of view, LEARN is an environment in which it is easy to add and take away materials and edit the BBSs

From the administrator's point of view, LEARN offers facilities to register students, teachers, courses, enrolments, available materials, etc., on the host

The general model for LEARN is: retrieve material on-line, logoff and work off line on materials? go back on-line to send materials back or discuss the materials

Six in-service courses are currently taught with LEARN support (Larsen & Malmberg, 1991)

3.2 Extending the in-service course with subsequent on-line interaction

One very powerful application of CCT to in-service teacher education is to extend the contacts and interaction that have been made in a face-to-face in-service course after the course is over. There are many examples of this model, such as the following:

CAWP On-Line: Extending an In-service Course

The CWAP is a method for improving the teaching of writing which involves a 90-hour Summer Institute or a 30-hour site-based course. The method has been delivered to over 3,100 teachers on the USA

A major intention of the method is that the participants become expert teachers of teachers after they finish the course, but this expectation means that there is much contact and follow-up needed after the course

Thus a computer conference was established, called CAWPOn-Line, specifically for the teachers who had finished the method training.

The Service offers e-mail, 45 "general discussion centres" (conference topic areas), file transfer, access to an on-line information resource that provides access in turn to data bases and other resources

Approximately half the potential users do in fact become high users of the Service, predominately the e-mail aspects (Fine, 1993)

This example leads into the last category of CCT and teacher education: that of support for on-going professional development.

4. CCT and support for on-going professional development

By on-going professional development we mean a variety of activities, with a common characteristic that the teacher chooses the activity him or herself, not because it is part of a course assignment, but because the teacher finds it helpful and/or stimulating. Sometimes these activities may be directly focused on a particular problem or task; other times they will be more diffuse, a response to a feeling of general interest, or more theoretical, such as the desire to reflect over one's professional practice. In this range of activities, CCT also can play an important role.

4.1 Supporting the teacher's information needs

Teachers more and more often are turning to on-line Network services to their specific information needs. Sometimes information comes from stored collections of materials, other times from specific persons. But in either case, an on-line Service, or access to the Internet itself, is increasingly popular among teachers. Honey and Henrjquez (1993) in their survey of US teachers using telecommunications found that the responding teachers valued very highly the on-going sorts of professional support that they could acquire through CCT activities. Teachers indicated they appreciated accessing educational research, downloading curriculum materials, accessing libraries, and researching subject-specific data bases.

4.1.1 "CISO" services.

In many countries and regions there is a particular Network Service specially organized for teachers. In The Netherlands we are calling these "CISOs", which comes from the first letters of the Dutch words for "Communication and Information Systems for the Educational Sector" (Collis, Veen, & De Vries, 1993). In research which we have recently carried out, we have analyzed "CISO"-type services in countries throughout Europe and beyond. We have found that the majority of European countries, US states, and other Western educational jurisdictions have such a service, usually supported by the Ministry of Education, but with many variations on partnerships.

A CISO-type service can be described by its functionalities - what it offers its users, or by its organisational and strategic aspects. An example of the first approach is shown in the following illustration:

A Network Service for Teacher Education and Support:

In the state of California in the USA a Network Service called OTAN has been established. OTAN stands for Outreach and Technical Assistance Network. The Service is focused on support for teachers working with students have special needs.

OTAN combines a computerized communications system with -regional resource libraries that disseminate commercial and teacher-made materials, including training

packets with accompanying videotapes, resource documents, and public-domain software.

OTAN is both an electronic archive and a distribution source for materials, reports, and studies.

Options to choose from in OTAN include: The Master Calendar, Who's Who, Department of Education Information, Resource Centres, Current Articles, Course Outlines, Curricula Resources, Lesson Plans, Public Domain Software, Demo Software, Legislative Information, Reference Materials, Educational Funding Sources, Job Opportunities, On-Line Discussions, and an Upload Area (U.S. Congress, Office of Technology Assessment, 1993)

Sometimes such educationally oriented on-line services emphasize the support of information searching as was the general case with the OTAN example above. Other times the focus is more on communication (see, for example, a Norwegian example, Braatane, 1993). In many cases, the Service offers both, and teachers react enthusiastically (Collis, Veen, & De Vries, 1993).

4.2 Smaller-scale support systems making use of CCT

The above illustration involved a Service organized to serve a broad public, via access through public telephone lines. There are many other sorts of "electronic performance support systems" being used by teachers for both the support of their work and also their on-going professional growth, that usually are based in one computer system but allow connectivity to external networks. The following is an example:

A Teacher Toolkit: Performance Support Involving CCT

In British Columbia, Canada, a software environment has been created for teachers to help them in their work. This integrated environment continues many different sorts of aids useful to them in categories such as: Accessing and developing lesson strategies; Recording, evaluating, and reporting student progress; Planning and scheduling; and Accessing and developing resources

Options often involve automatic use of CCT to connect the teacher to collections of information or resources available not in the computer itself but in district or regional centres

Teachers can add material themselves to the regional collection. They can also use the Toolkit to make contact (simply through the click of an icon that looks like a telephone) to a specialist in a regional centre or to colleagues in other schools (Hoebel & Mussio, 1990)

Such performance-support environments are becoming very popular, and have many variations. Often they may include access to an interactive videodisc of visual resources, for example of video clips of different sorts of lesson activities in actual classroom settings. The boundary between getting information and learning overlaps when a teacher uses such a resource.

4.3 On-going teacher education through computer-supported networking

By networking in this sense we mean that teacher becoming part of a supportive and interacting group of colleagues who interact with each other, giving each other support and ideas. Computer-based communication technologies are rapidly enlarging the range

and composition of the groups with which a teacher can network. The following illustration shows this kind of networking:

LabNet: A Network to Develop a Professional Community of Practice Among Science Teachers

The LabNet Project in the US was a three-year, multi-part project whose overall goal was to improve classroom science teaching. But building a "professional community of practice" among teachers involved in the project was seen as a major aspect

The; 562 teachers involved were from 37 US states. They interacted with each other occasionally in face-to-face small groups in their own regions but most generally through computer conferencing

The goal of the conferencing was to increase the teachers' self-reflection about their classroom practice, but they also used the computer conferencing to exchange ideas about classroom activities and to interact with professional scientists who were also part of the Network community

Occasionally teachers would be sent new sets of software and learning materials and then would use the computer conference to receive instructional help from Project Leaders and to support each other in their problems and experiences in trying new computer-based activities in the science classroom (Gal, Ruopp, Drayton, & Pfister, 1993)

This illustration shows a Network for professional development being guided by a professional project-leadership team and integrated with a range of other types of inservice activities. There are many examples of Network communities, with varying degrees of formality and of associated in-service activity. We saw an example above, relative to the teaching of writing; there are examples in many disciplines and in many countries. Often a special feature of such a Network community is the presence of persons who the teacher in his or her ordinary practice would never have the opportunity to meet. For example, physics teachers in California involved in such a Network were able to electronically interact with the authors of the textbook they used in their teaching with on-going questions about the text and its support activities. "Telementoring" relationships are developing of a type not likely to occur in the teacher's ordinary range of contacts (Wighton, 1993). Such use of computer conferencing for networking among teachers is being seen as a major stimulus for teachers' professional development, as

...teachers, like students, [who participate in co-operative on-line communities] acquire knowledge, develop teaching/learning strategies, increase self-esteem, and develop meaningful relationships with their peers" (Riel, 1990, p. 452)

5. Anticipating constraints and seeking the most effective possibilities for CCT and teacher education

5.1 Anticipating constraints

The illustrations above have only touched the surface of many new types of teacher-education experiences now being facilitated by computer-based communications throughout the world. But such activities, like all innovations in educational practice, bring with them many different constraints to their implementation. There are predictable problems in many areas:

- Finding sufficient support and financing to connect teachers to an appropriate and affordable telecommunications infrastructure
- Organizing and managing a Network Service so that it offers timely and well-conducted information and communication settings for teachers
- Helping teachers learn how to use such an environment
- Providing adequate access to such an environment so that teachers can use it for sometimes lengthy periods of time as they engage in discussions and look for resources on-line
- Designing software to support teachers' on-line activities
- Anticipating the amount of time and the steps that will be needed for teachers to adopt such an innovation into their practice
- Searching for strategies to moderate on-line discussions so that they proceed productively
- Searching for ways to locate and organize resources that will be obtainable on-line
- Helping teachers have the time and motivation to engage in reflective, selfdirected learning activities outside of a formal in-service structure
- Motivating faculty in teacher-education institutions to become aware of and to participate in electronically supported communities of practice

Each one of these points is being addressed by various research projects at the Faculty of Educational Science and Technology at the University of Twente, as well as in many other locations throughout the world (see, for example, Collis & De Vries, 1993; and Collis, Veen, & De Vries, 1993).

5.2 Identifying effective applications of CCT for teacher education in the current European context

In order for a complex innovation such as the use of CCT for teacher education to gain acceptance and momentum, some sorts of applications of it must be identified that are most likely to capture support (we call these "trigger events", Collis & De Vries, 1993). In the current European context there seem to be at least two such types of applications that could be good candidates for stimulating the use of CCT in teacher education. One application relates to developing the European dimension in education, and the other to strengthening language teaching.

5.2.1 *Developing the European dimension.*

Throughout Europe, both the Community and more broadly, there is a great interest in developing the "European dimension" in education. The new Community Programme "Socrates" is based on this motivation. A major way this occurs is through exchanges, both of teachers and of students. But despite the efforts of many different programs such as ERASMUS to stimulate such exchange, doing it physically is not possible for the majority of teachers and students, or for the majority of faculty at teacher-education institutes (Delmartino, 1993; Miller & Taylor, 1993). Constraints on mobility are financial, institutional, and practical. On-line activities via CCT can compensate for physical restraints. Networking can become a powerful parallel activity to physical exchanges in the European context.

5.2.2 *Focusing on language teaching*

A particularly important educational need in Europe is the development of multiple-language facility, not only among students, but also among their teachers, and teacher-educators. The 1994 "Expolangues '94" language-teaching exposition, held in Portugal, attracted more than 30 000 visitors. Projects and activities involving distance-education methods for language teaching and the support of language teachers are in operation at the international level (see Berlitz & Fischer, this volume), the national level (see, for example, the Danish project "Foreign Language Learning in Relation to New Technology and to Strategies for Teaching On-Line" (Lorensen, 1991), and the professional level.

There is a particular need for language upgrading among teacher educators and foreign-language teachers in Central and Eastern European countries. In these countries the wide-spread lack of knowledge of Western European languages is prohibiting integration into many activities with a "European dimension". Thus it would seem that a concentrated focus on a variety of applications of CCT for co-operative teacher education activities involving Western European languages could be a particularly productive strategy. The Workshop "Teacher Education and Communication and Information Technologies" is an excellent setting for exploring how to go further with foreign language strengthening as a "trigger event" for the use of computer-based communication technologies in teacher education.

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